EFFECT OF Zr ON STRUCTURE AND MECHANICAL BEHAVIOUR OF Ti-Al-Si ALLOYS

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Ti-Si system as before attracts attention of researchers due to the fact that employment of a variety of reinforcement mechanisms working in different temperature ranges (microstructure control, solid solution hardening, eutectic and composite hardening, ageing) is possible in the Ti-Si-based multi-component alloys in design of structures having desirable properties [1-5]. It is known that Si increases a thermal stability of titanium alloys. Increase of Si content above its limited solubility results in formation of silicides. Zr is used to improve high temperature properties of titanium alloys, giving rise to enhancement of hardenability and structure modification. At the same time, Zr reduces solubility of Si in α-solid solution and promotes silicide precipitation. Besides, increase of Zr content gives rise to formation of ternary compound $(Ti,Zr)_2Si$. At that in systems Ti-Si-Zr and Ti-Al-Si-Zr occurrence of ternary eutectic $L \rightarrow \beta\text{-}Ti+Ti_5Si_3+(Ti,Zr)_2Si$ is visualized [4]. It should be noted that any systematical data about mutual influence of Si and Zr in wide concentration ranges on structure and mechanical behaviour of titanium and titanium-aluminium alloys are absent in literature.

Investigation of features of structure, phase composition and mechanical properties of Ti-3Al alloys alloyed with Si (0-6 wt.%) and Zr (0-18 wt.%) was performed in this work. A comparison of mechanical behavior of alloys based on eutectic (α-Ti + Ti_5Si_3) and (α-Ti + $(Ti,Zr)_2Si$) was carried out.

Methods of optical metallography, scanning electron microscopy, X-ray structural analysis, measurement of Vickers hardness and long-term hardness were used. Mechanical tensile tests were made in temperature range of 20 ….800 ^{0}C.

It is shown that α-Ti+Ti_5Si_3 eutectic-based Ti-3Al-6Si-5Zr alloys possess optimal combination of mechanical characteristics at high temperatures up to 600^{0}C. Additional alloying of the alloys with β-stabilizing elements and tin results in their improved high-temperature strength at temperatures up to 700^{0}C, a satisfactory processibility and fracture toughness.

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